August 2020

**Urgent concerns regarding potential pollution in water ways and possible impacts on ecological systems and research programs at Eastern Nebraska Research and Extension Center (ENREC) in Mead, Nebraska**

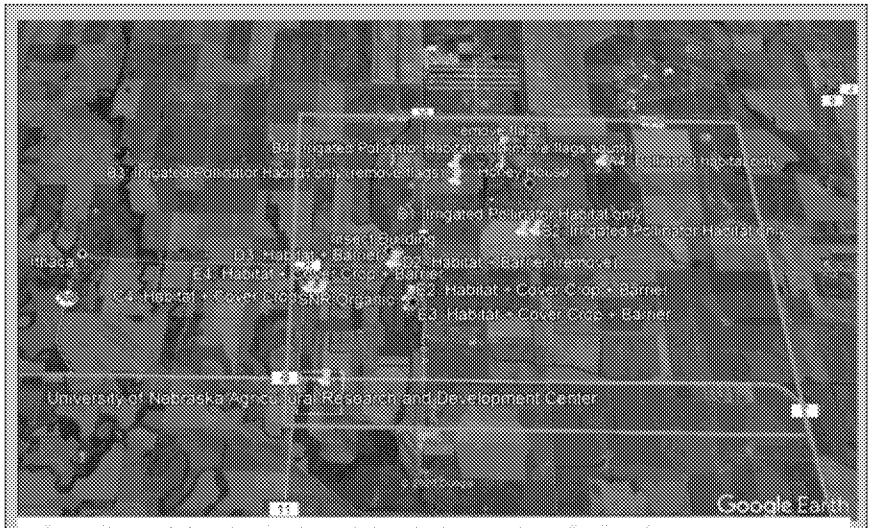
Judy Wu-Smart
Assistant Professor & Extension Specialist
Department of Entomology
Email: jwu-smart@unl.edu
Teleworking contact number: (925) 305-7588

## ABSTRACT:

The UNL Bee Team currently maintains 85 honey bee colonies in 8 research and teaching apiaries across Nebraska. In the past 3-4 years, there have been consistent and rapid losses of honey bee colonies only at our research apiaries around the Eastern Nebraska Research and Extension Center (ENREC) in Mead, Nebraska. My predecessor, Marion Ellis, successfully kept bees and made ample honey at ENREC prior to 2013. However, since 2017, we have lost every hive placed at ENREC, over 36 hives impacting our research program by roughly $21,000 for the cost of bees, contaminated equipment, and loss honey revenue. Placement of hives at ENREC was necessary for several funded projects, including a multistate project. Investigations into the timing, extent, and duration of bee losses coupled with pesticide residue data of milkweeds collected around ENREC have lead us to believe that the water ways (streams, ditches, and channels) running through ENREC has potentially high levels of pesticide residues, including several systemic insecticides and fungicides common in seed coat treatments. The potential point source for this water contamination likely originates from an ethanol plant (from here on referred to as "Ethanol Plant X") located directly north of ENREC. Typically, ethanol plants process harvested grains as a primary carbohydrate source in the ethanol process, however, "Ethanol Plant X" is processing millions of pounds of outdated surplus treated seeds which result in highly contaminated discharge water and waste vegetation also known as mash or wetcakes. The NE Department of Environment and Energy (NDEE) sampled water from the discharge lagoons as well as wetcakes (in April 2019) showing levels of neonicotinoid insecticides clothianidin and thiamethoxam around 30,000-50,000 ppb and several fungicides as high as 200,000 ppb. The solid wetcake had twice as much neonicotinoid at 112,000 ppb clothianidin, 30,000 ppb thiamethoxam and, again, several fungicides were detected at high levels (Appendix A). For reference, the maximum daily oral dose for neonicotinoids in food and water set by the US EPA to avoid appreciable risk of harm in humans ranges from ~0.004-0.07 mg/kg/day or 4-70 ppb.

Here, we report three main areas of concern that require immediate attention by the research community and local residents: 1) contaminated effluent and lagoons overflowing into nearby waterways, 2) the distribution of highly contaminated wetcake soil amendments across Nebraska. And 3) the use of nitrogen-rich (and pesticide-laden) discharge water from holding tanks as irrigation on fields. Bees are biological indicators of the surrounding environment and unfortunately pollinator protection policies currently prevents regulatory agencies from investigating these beekills because the colonies did not die from a misuse of a pesticide application but rather likely from contaminated water and forage (nectar/pollen). We have yet to identify the exposure pathway causing mortality in our managed honey bees as well as observed low abundance and diversity of wild pollinators at ENREC but have refocused research aims to do so. Nebraska's beekeeping industry is struggling and high losses of colonies in recent years indicate potentially larger statewide issues for which the causes of bee health decline require further assessment, particularly in context of the use of contaminated soil amendments by unknowing farmers. Additionally, the inability to keep bees alive around ENREC indicates a greater One Health concern highlighting the urgent need to examine potential impacts on local communities and wildlife as well as other research programs at ENREC. We seek feedback and financial seed funding to begin gathering primary data that will allow us to launch a wide scope examination of the concerns listed above as well as potential environmental, ecological, and human health impacts.

**INTRODUCTION TO BEE KILL PROBLEM AND TIMELINE:** I began my position at UNL in the Fall of 2015 and shortly after was awarded multistate hatch project funds to examine the role existing tree lines play as potential pesticide drift barriers. With those funds we aimed to examine whether tree lines can protect pollinator habitat from unintended exposure to crop field dust laden with seed treatment pesticides during corn planting (Map 1). In 2017, we set up 17 small plots of pollinator habitat adjacent to corn fields with or without drift barriers at the Eastern Nebraska Research and Extension Center (ENREC), formerly the Agricultural Research and Development Center (ARDC), research farm in Mead, Nebraska. Also in 2017, we set out 4 hives at the Insect Building at ENREC. All four hives rapidly died for no apparent reason, and we were only able to capture some photos of high losses of workers in the front of hives that year. In 2018, my PhD student began monitoring pollinator visitation rates at the newly established pollinator habitat plots and sampled vegetation from these plots and other vegetation near adjacent crop fields. We also set out 9 honey bee hives in 3 locations near a few of the pollinator habitat plots (Insect Field Laboratory, Honey House, and SNR organic fields) and deployed dead bee traps as monitoring tools to better assess the extent of losses (see Map 1 and Fig 1). These hives also quickly died, and we sent a sample of dying bees to the USDA-AMS National Science Laboratory in Gastonia, NC.




Map 1: Map of the UNL Eastern Nebraska Research and Extension Center (formerly Agricultural Research and Development Center) which consists of 93,000 acres of farm research property (outlined by blue box). Map also illustrates the 17 pollinator habitats (yellow pins) and the three apiaries (pink pins) established for the Multistate Project: Wu-Smart, J. (Principal Investigator), Golick, D. (Investigator), Weissling, T. (Investigator), Peterson, J. (Investigator), Koehler-Cole, K. (Investigator), IC-1792, Grant, "NE1501: Sustainable landscape solutions to reduce pesticide exposure and promote establishment of beneficial insect and pollinator communities in agricultural areas", Internal, $300,000.00, Awarded. (start: October 1, 2016, end: September 30, 2020)

The USDA laboratory screened for over 180 different compounds and results showed a few moderately high levels of a neonicotinoid insecticide common in seed treatments, but nothing extremely high that could definitively explain our rapid honey bee colony losses. It's possible that the relatively low residue levels detected in the hives may result from: 1) the compounds in the dead bees rapidly degrading (e.g. neonicotinoids are photosensitive and degrade quickly under UV light); or 2) honey bee foragers exposed to contaminated forage were unable to return to the hive (thus the colony suffers from malnutrition/dehydration), or 3) the compound impacting bees was not one of the 180 screened compounds. While the exact exposure pathway occurring has not yet been identified, at this point we suspected that something environmental was causing the observed impacts because when we observed elevated mortality of honey bees,

particularly in the Spring (May-June), my PhD student performing pollinator surveys also noted concurrent low abundance and diversity of wild bees, butterflies, flies, and beetles.

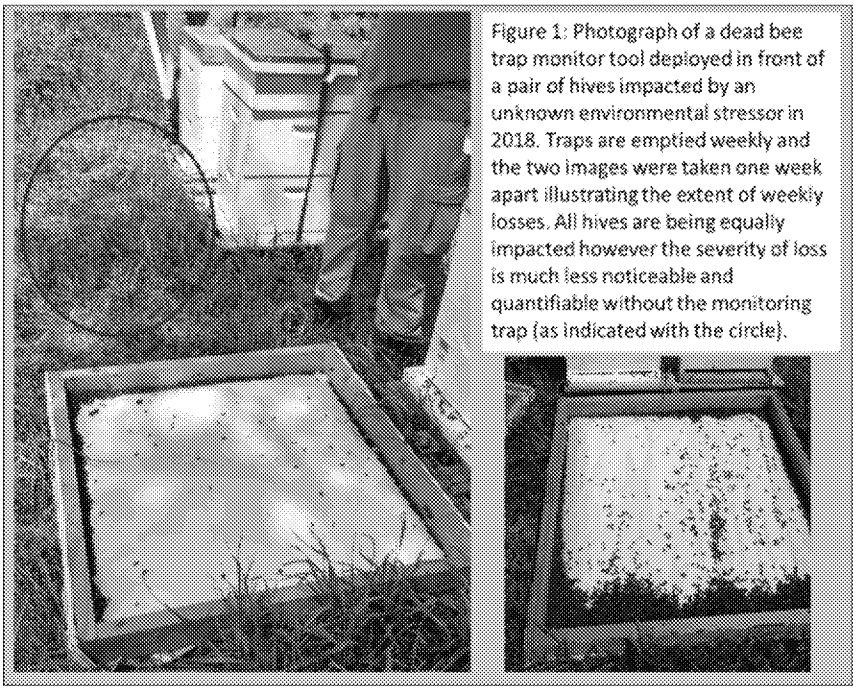


Figure 1: Photograph of a dead bee trap monitor tool deployed in front of a pair of hives impacted by an unknown environmental stressor in 2018. Traps are emptied weekly and the two images were taken one week apart illustrating the extent of weekly losses. All hives are being equally impacted however the severity of loss is much less noticeable and quantifiable without the monitoring trap (as indicated with the circle).

In 2019, we deployed 4 hives at the Insect Building in July thinking we would miss corn planting by about 2+ months and possibly avoid any exposure causing the losses but we still had significant mortality in the adult honey bee populations. This further indicated a more chronic and persistent stressor. By the end of the growing season, these colonies were severely weakened but were not a total loss as in previous years. We also collected and sent several samples of milkweed leaves collected near crop fields for testing to assess potential exposure rates on non-target monarch butterfly caterpillars that consume milkweed leaves, and other pollinators, such as wild bees, that forage on milkweed nectar and pollen. Some of the milkweed leaves yielded residue levels at extremely high levels, up to 3,000-5,000 ppb clothianidin. We contested the validity of these results since there has never been levels reported at this magnitude even when a soil drench is applied directly to a plant. Only a few studies show neonicotinoid residues at those levels in soil injected trees,

Figure 2: Dead bee traps used in 2020 to continue monitoring chronic bee losses at ENREC. Pictures show 3 hives equipped with traps and 1 hive without (left, middle). All hives are being equally impacted however the severity of loss is much less noticeable and quantifiable without the monitoring trap (right). These hives also have pollen traps and weight scales to better assess seasonal colony decline and foraging preference.

and in those cases the neonicotinoid compounds were imidacloprid and dinotefuran, not clothianidin and thiamethoxam, which are more typically used as seed coat treatments. We then sought internal Faculty Seed and Layman grants to further pursue the pesticide exposure studies to examine air and soil exposure rates utilizing the UNL Water Laboratory rather than the previous USDA-AMS lab. Unfortunately, the UNL Water Lab had not developed methods to test for residues in milkweed leaves so we could not re-run those samples. This year (2020), we again deployed honey bee hives to ENREC in mid-May (~1-2 weeks after corn planting) and within less than a week we begin observing rapid declines in adult bee populations (Figures 2 & 3). I have attached video files showing bees dying and exhibiting classic symptoms of exposure to a nerve toxin (shaking, trembling, and locomotor impairment) typical of most insecticides (Videos 1 & 2).

After further examination of the distribution of field-collected milkweeds with high clothianidin residues detected in leaves, we determined the mostly likely route of exposure for these milkweeds is coming from the water system and not crop fields. Milkweed plant tissue collected along the tree line and near the intermittent creek around the Insect Field Building had levels ~1600-3600 ppb, while plant material collected just a few meters away from the tree line and farther away from the water way exhibited a 100-fold decrease in residue levels (~36ppb).

**DISCOVERY OF AN ETHANOL PLANT CONTAMINATION ISSUE:** Given the high milkweed residues and proximity to the waterways, I reached out to the NE Department of Agriculture (NDA) Pesticide Division on May 20, 2020 to inquire about any mosquito abatement or some other water treatment the city or county officials may to applying. An official with the NDA Pesticide/Fertilizer Program responded and indicated there was a current water contamination issue with an ethanol company located directly North of the ENREC property. In the email they state:

*""Ethanol Plant X" is using treated seed corn as their primary carbohydrate source for ethanol, and while they have the treated seed stored inside of covered warehouses, we have learned that the distillers dried grain wetcake coming out of the distillation process is heavily contaminated with just about everything used in the seed treatments. I don't know how attractive this byproduct would be to honey bees, but "Ethanol Plant X" has been stockpiling the wetcake on the property, and the waste water is held in two large lagoons as well. Both the wetcake and lagoon water have high concentrations of neonics, pyrethroids, and multiple fungicides that have been implicated in causing bee gut dysfunction. The unfortunate bottom line is that our complaint response policy requires that we have a good idea of a possible*

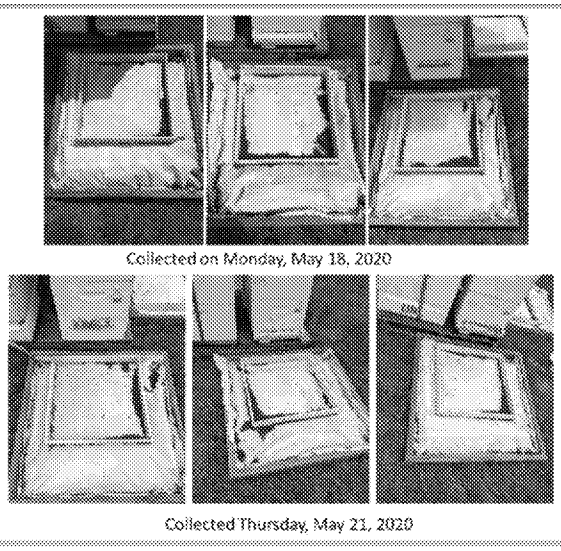



Figure 3. Hives were deployed at ENREC on May 12th shortly after corn planting. Photos (top row) show adult honey bee mortality 6 days later. Traps were emptied on May 18th. Photos also show equivalent losses only 48 hours later on May 21st (bottom row).

*source of pesticide causing a problem, and without a solid lead of where pesticides might come into contact with the bees, we really can't conduct a regulatory investigation, it is more along the lines of a research investigation*."

My predecessor (Marion Ellis) kept bees at ENREC with high success (colony survival and honey production) until his retirement in 2013. Between the time of his retirement and my start date at UNL something dramatically changed in the suitability of this landscape for honey bees. "Ethanol Plant X" has been in operation for around 14 years, but Google Earth historical imagery and visual markers suggests their operation became more active since 2006. Further, the white structures housing treated seed prior to processing appears in 2016 indicating they began processing large quantities of treated seed within the last 3-4 years. While these lagoons are likely a point-source contamination issue polluting the waterways, we have further learned that in fall of 2018 "Ethanol Plant X" was issued a permit to sell and distribute wetcake as a soil amendment. At the time, NDA was under the assumption that they were processing harvested grain as the primary source of carbohydrate in the ethanol process. NDA began receiving complaints in the late fall and winter of 2018/2019 regarding the odors emanating from the rotting vegetation mash, or wetcake, material which is when they discovered the plant was processing treated seed rather than harvested grain, as is the case for most other ethanol plants.

There is currently ongoing enforcement of some regulatory oversight by NDEE at "Ethanol Plant X" so I am not clear on the details but I am told this is in regard to the selling of wetcake as a soil amendment without disclosing the presence of chemical residues in the wetcake. Therefore, "Ethanol Plant X" has been processing millions of pounds of surplus, outdated treated seed and dispersing highly contaminated soil amendments to farmers across Nebraska, likely unbeknownst to them. NDA became aware of the issue through local complaints of sick and dying wildlife (geese and other birds) and pets becoming sick or dying in fields with "Ethanol Plant X" soil amendments (Figure 4).

Figure 4: Wetcake soil amendments piled on local farmers property and spread across crop fields (Photos taken by NDA).

**RESEARCH NEEDS AND KNOWLEDGE GAPS:** On June 8, 2020, we met with several NDA and EPA officials regarding "Ethanol Plant X" and the bee kills (Table 2). The following are some key take-aways from the meeting:

- Risk Assessors (NDA, EPA) rely on incident data and require strong evidence identifying exposure pathways. Our data currently is limited so we inquired about state and federal funding to help investigate these losses. Because I suggested my bees did not die from suspected misuse of a pesticide application but rather potentially from water pollution it does not qualify under those strict pesticide protection guidelines and regulations. Therefore, despite the classical acute poisoning observed in these hives (from pesticide exposure), the onus to collect more data and complete intensive pesticide testing is on us, and NDA and EPA are unable to help.

Table 2: List of UNL, NDA, and EPA officials on the initial conference call regarding beekills at ENREC (June 8, 2020)

| UNL | Email |
|---|---|
| Mark Schroeder | mark.schroeder@unl.edu |
| John Ruberson | jruberson2@unl.edu |
| Douglas Zalesky | dzalesky2@unl.edu |
| | |
| **NE Department of Ag** | |
| Tim Creger | tim.creger@nebraska.gov |
| Tammy Zimmerman | tammy.zimmerman@nebraska.gov |
| Buzz Vance | buzz.vance@nebraska.gov |
| | |
| **Regional EPA (#7)** | |
| Michael Daniels | daniels.michael@epa.gov |
| Jamie Green | Green.Jamie@epa.gov |
| | |
| **National EPA** | |
| Tom Steeger | Steeger.Thomas@epa.gov |
| Edwin Buckner | |
| Mike Martin | |

- EPA and NDA are only aware of two plants ("Ethanol Plant X" and another in Kansas) that process treated seed and feel these are isolated cases; however, initial awareness of these plants came through local complaints. Therefore, their complaint-based policy does not allow for thorough assessment of how widespread this practice is across the nation.
- While the distribution of wetcake soil amendments by "Ethanol Plant X" has stopped, we do not know how long, how much, and where these highly contaminated soil amendments were distributed.

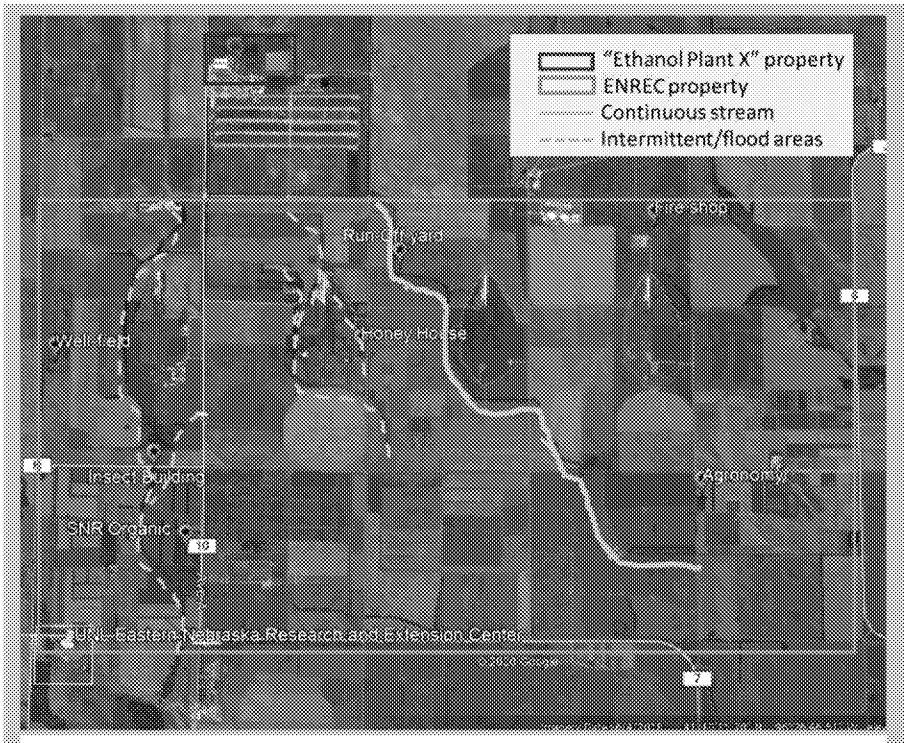
The practice of processing surplus treated seed through ethanol plants is a recommended method of disposal for treated seeds (https://pesticidestewardship.org/disposal/treated-seed-disposal/; https://seed-treatment-guide.com/wp-content/uploads/2019/04/ASTA_SeedGuide_Applicators_Update.pdf). However, there are three main areas of concern that require immediate attention by the research community and local residents: 1) the contaminated effluent and overflowing lagoons, 2) the distribution of highly contaminated wetcake soil amendments across Nebraska. And 3) the use of nitrogen-rich (and pesticide-laden) discharge water from holding tanks as irrigation on fields.

**CONTAMINATED LAGOONS AS A POTENTIAL POINT SOURCE:** To my knowledge, there is one main continuous stream and several intermittent creeks, channels, and ditches around ENREC that fill up when it rains. When lagoons from the "Ethanol Plant X" property overflow, the water runs through ENREC (Map 2). I have attached pesticide data from the NE Department of Environment and Energy (NDEE) sampled from the lagoon and overflow lagoons as well as wetcake collected in April 2019 showing levels of clothianidin and thiamethoxam around 30,000-50,000 ppb and several fungicides as high as 200,000 ppb. The solid wetcake had twice as much neonicotinoid at 112,000 ppb clothianidin, 30,000 ppb

thiamethoxam and, again, several fungicides were detected at high levels (Appendix A). For reference, the maximum daily oral dose for neonicotinoids in food and water set by the US EPA to avoid appreciable risk of harm over a lifetime ranges from ~0.004-0.07 mg/kg/day or 4-70 ppb. I am currently trying to reach the NDEE persons involved in this matter to seek more information about whether storm drains and other surrounding streams were tested.

## WETCAKE (DISTILLER'S GRAIN) SOIL AMENDMENTS & REGULATORY LOOPHOLES:

Most ethanol plants utilize harvested grain as the primary source of carbohydrate, and the processed mash material, called distiller's grain, is often sold as an economically marketable, highly nutritious supplemental feed for livestock. However, processing treated seed leads to detectable levels of chemical residues that exceed allowable tolerances for livestock feed; therefore, the waste product may be alternatively marketed as a less economically valuable soil amendment product. This is arguably an economic disincentive for ethanol plants to process treated seed and regulatory personnel feel that, because of this reason, the issue is isolated and the practice is self-regulated.




Map 2: Map shows location of 2020 hive locations (pink markers), "Ethanol Plant X' and ENREC property lines, as well as general locations of continuous and intermittent water ways that run through ENREC.

Despite having very high levels of detectable seed treatment insecticide and fungicide residues, soil amendments derived from pesticide-treated seed are not classified as a pesticide because seed treatments are exempt from pesticide classification. Therefore, there are no guidelines or recommended application rates that take into consideration potential exposure risks to non-target wildlife and other adverse environmental impacts. NDA issued a "stop sell and use" order to "Ethanol Plant X" in June 2019 (Appendix B & C); however, large stockpiles remain on property and in close proximity (0.75 miles or 1.21 kilometers) to ENREC (Map 3, Figure 5). Given the systemic nature of seed treatment compounds, there is a high probability of non-target uptake of these systemic compounds from wetcake into surrounding native vegetation and field crops, as well as potential run-off concerns into and systemic plant uptake from waterways. Unregulated and high levels of these

compounds in the landscape cause concerns for residue levels exceeding allowable tolerance levels in food crops and livestock nearby. Further, highly persistent compounds may quickly lead to pest insects becoming more resistant to chemical interventions, rendering legal pesticide application rates ineffective at controlling resistant populations. Therefore, I am interested in soliciting local farmers that have used the "Ethanol Plant X" wetcake soil amendment product in 2017, 2018 and/or 2019, and who are willing to allow me to collect vegetation, soil, and water samples for pesticide residue testing to determine persistence and translocation of these compounds after wetcake soil amendments were applied. Seed funding to support initial sampling would allow us to collect preliminary data and then seek USDA-NIFA funding.


Map 3. Pesticide-laden wetcake stockpile located roughly 0.75 miles (1.21 km) from the ENREC property line (blue)

## EFFLUENT WATER, DISCHARGE USE, AND CONTAMINATION IN NEARBY WATERWAYS:

Those familiar with "Ethanol Plant X" practices note nitrogen-rich water from within holding ponds is pumped through irrigation systems and applied to local farms as soil enrichments and it's likely pesticide contaminants are present but not being screened, nor are there likely recommendations regarding application rates of the contaminated water.

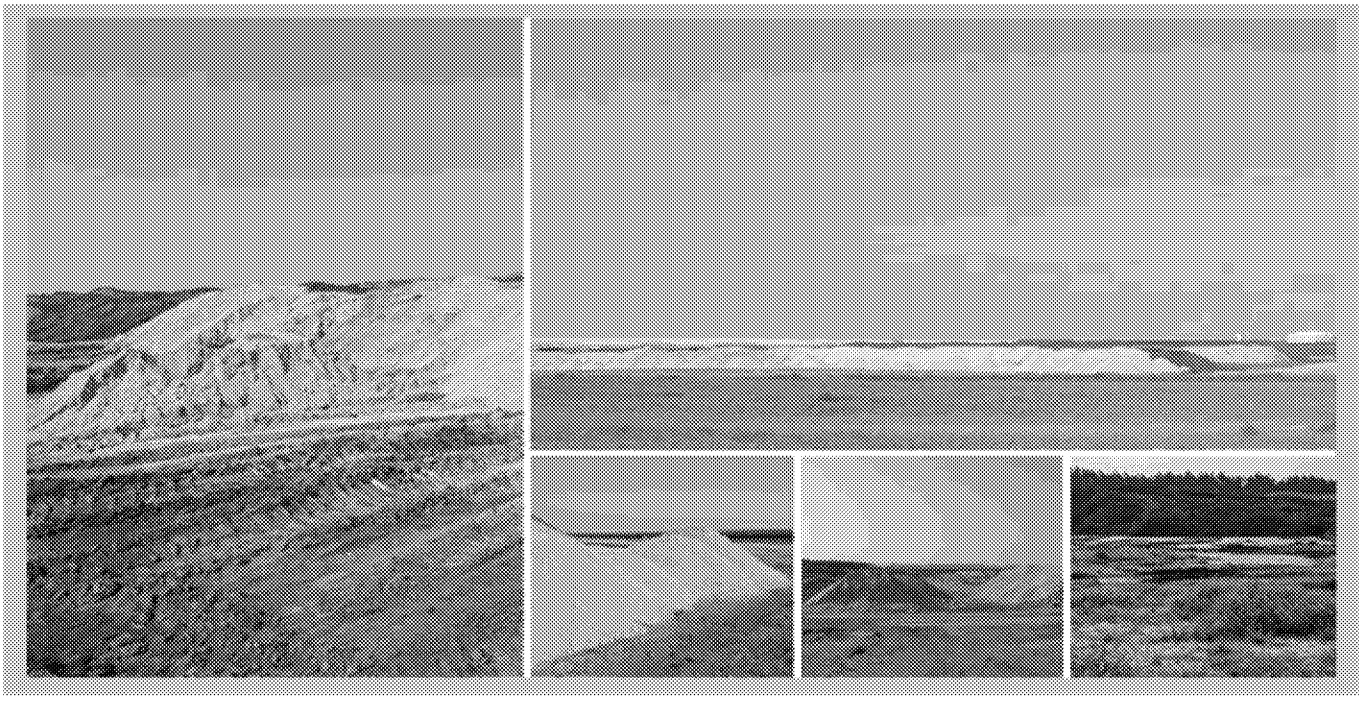


Figure 5. Pesticide-laden wetcake waste stockpiled outside just north of ENREC property. Photo taken July 6, 2020.

Mark Schroeder (Farm/Facilities Operations Manager) noted that ENREC also used the "Ethanol Plant X" effluent product in the fall of 2018 on fields 1307,08 (liquid injection) and 1311,1861 (surface application solids) prior to knowing about the pesticide contamination issues. Further, unsubstantiated allegations include the free delivery of wetcakes and discharge substances to local farmers in close proximity of the plant as well as the dumping of wetcake waste in a public landfill now that the stop use and sell order is in place.

The pesticide data we have on milkweed leaves and soil collected around ENREC are too limited to determine whether these milkweed plants were contaminated by the water or to identify the ethanol plant confidently as a point source causing pollution in waterways. However, the streams and creeks running through ENREC urgently need to be systematically tested and monitored to identify potential accumulation and/or persistence of residues. My PhD student also set out sticky traps from 2017-2019 to capture air particles and assess neonicotinoid exposure levels coming from corn fields with and without tree lines. While we have not fully analyzed the sticky trap data yet, preliminary review suggests the locations closest in proximity and facing toward the ethanol plant exhibited the highest residue levels of clothianidin (up to 5,000 ppb) while residue levels were less detectable farther from the plant. Unfortunately, our original experimental design and treatment groups did not consider this confounding factor and we need to resample water, soil, and vegetation (foliage, nectar, and pollen) both up- and downstream from the ethanol plant as well as adjacent to the creeks and streams. Further, sampling efforts should be made at incremental distances away from water sources to determine whether ENREC waterways are contaminated with seed treatment residues, and at what levels. This will help

Table 1: Potential routes of chemical exposure from ethanol processing contamination on non-target honey bees

| Contamination Source | Likely exposure method | Potential effects | Cascading impacts |
|---|---|---|---|
| Surface/Ground water | Contaminated water | Water foragers die away from hive | Dehydration? |
| Surface/Ground water | Contaminated nectar | Either nectar foragers die away from hive (direct effect).<br><br>Foragers return and distribute contaminated nectar stores throughout hive (direct & indirect effect) | **Direct:** If foragers die away from hive that may lead to malnourish hives.<br>**Indirect:** Various behavioral effects have been documented including impaired foraging, cognitive tasks (learning, memory, orientation), greater susceptibility to other diseases, reduced egg laying and hygienic performance. |
| | Contaminated pollen | Disproportional loss of brood-caring nurse bees | Malnutrition in brood, higher rates of mortality (spotty pattern), and greater susceptibility to brood diseases. |
| Wetcakes | Direct feeding from fermented product | Foragers die away from hive (direct effect) | **Direct:** If foragers die away from hive that may lead to malnourish hives. |
| | Contaminated nectar/pollen through soil amendment residues | Leeching residues may be taking up by non-target plants & expressed in nectar/pollen | **Direct:** If foragers die away from hive that may lead to malnourish hives.<br>**Indirect:** Various behavioral effects have been documented including impaired foraging, cognitive tasks (learning, memory, orientation), greater susceptibility to other diseases, reduced egg laying and hygienic performance. Malnutrition in brood, higher rates of mortality (spotty pattern), and greater susceptibility to brood diseases. |
| Ethanol volatiles | ? | ? | ? |

determine whether the ethanol effluent and discharge lagoons are a point source of water contamination, and to what extent.

## IMPACTS ON WILDLIFE, ECOSYSTEM FUNCTION, AND ENREC RESEARCH PROGRAMS:

In addition to testing waterways, we must determine whether pollinators and other wildlife are being impacted specifically by the pollution cause from the effluent lagoons by identifying exposure pathway(s) and to what extent populations are adversely affected. This is a difficult and complex question when examining the impacts of neonicotinoids on social insect systems, like honey bees and bumble bees. Numerous studies on social bees show that reproductive individuals (queens and drones) and worker bees exhibit impaired behavioral and cognitive functions at oral exposure levels as low as 10-100 ppb. However, we are uncertain whether dying bees at ENREC are becoming exposed through water, nectar, and/or pollen, although a likely scenario is via all three. This speculation is supported by video evidence demonstrating intoxicated bees dying with their heads in nectar cells inside honey bee colonies, and large quantities of dying young nurse bees who disproportionately consume large amounts of pollen to produce glandular brood food secretions (Videos 3-5). Table 1 summarizes several potential routes of exposure through various contamination sources and follows the likely exposure method that may lead to potential direct and indirect effects on individual honey bees. Table 1 also details cascading impacts at the colony-level that may adversely affect colony growth and thus pollination service capacity and economic honey production for beekeepers. Future funding into exposure pathways will focus on examining several of these factors and potential direct and indirect effects.

## BEES AS BIOINDICATORS OF POTENTIALLY GREATER ENVIRNOMENTAL ISSUES:

In addition to our struggling honey bee colonies and low abundance of wild pollinators, we also observed sick and impaired butterflies and birds feeding on dead bees (Videos 6-8). I recorded and posted the video of a bird feeding from the dead bee traps (Video 6) on Twitter on July 1, 2020 to crowd-source information about the species and Thomas Labedz (NU State Museum) noted that it was a juvenile horned lark and it was "about the oddest behavior" he's ever seen in this species. Honey bees have been used as a biological indicator species for the quality of the surrounding environment. Given the severity and consistency of bee losses at ENREC and across Nebraska, we need to further assess what other beneficial insect communities (predators, aquatic insect bioindicators, and nutrient cyclers) are being affected, how continued losses of beneficial insects will impact pollination of wild and native plants and food crop systems, arthropod biological control agents that reduce pests in cropping systems, and whether disruption to ecological food webs are adversely affecting wildlife species that rely on insects as their primary food source. We must also consider that if biological indicator species like pollinators are struggling, then the causes for their decline may also potentially impact local wildlife and communities.

## NEBRASKA'S DECLINING BEEKEEPING INDUSTRY:

Nebraska does not have a mandatory beekeeper registry to track the number of beekeepers and colonies in the state each year. If we did, entities within Nebraska would have been more aware of many large-scale, commercial beekeepers pulling out of our state in the last 4-5 years. Brett Adee is the nation's largest beekeeper, maintaining almost 100,000 hives across 4-5 states. Mr. Adee kept roughly 17,000 -25,000 hives in Nebraska for several decades, up until 2019. Mr. Adee had high losses of colonies (60-80%) for 3 consecutive years and could not afford to maintain hives in Nebraska any longer. He is not the only beekeeper that has pulled their operation from Nebraska. Mark Brady kept 3,000 hives for 20 years in Nebraska and noticed dramatic reductions in productivity about 6-7 years ago and then began experiencing high losses of colonies about 3-4 years ago. There are more commercial beekeepers and several small operations that have all experienced low survivability in recent years. I estimated the loss of roughly 25,000-35,000 colonies in Nebraska in recent years which makes up a large proportion of the total hives typically reported for the state (40,000 to 80,000 hives depending on the season). The loss of incidental pollination services by managed and wild bees to local farmers is unfortunately unquantifiable and the lack of bees in our state has also been noted by many concerned homeowners and citizens observing the lack of insect activity in their gardens. These losses of beekeepers, managed honey bees, and native bees reduces the amount of pollination services provided to our state crops and native vegetation which reduces sustainability and resiliency in Nebraska's landscapes.

## ONE HEALTH CASE STUDY CHALLENGE:

In my investigation into this specific practice I have communicated with numerous researchers, regulatory experts, and non-profit interest groups who have previously worked on neonicotinoid issues and none were previously aware of this practice. I have recruited many UNL researchers and NE state partners to help target critical research needs to better understand and monitor the contamination issues resulting from "Ethanol Plant X" lagoon overflow water, discharged water for irrigation, and wetcake stockpiles, and distribution of wetcake soil amendments. Additionally, there are a number of external researchers and experts now looking more thoroughly into the legal and regulatory aspects of this issue which my team neither has the expertise, time nor funding to pursue. Additionally, the Nebraska College of Law is interested in learning more about these concerns. My team and several UNL researchers are keenly interested in collecting more information and, going forward in the near term, will focus on data gathering and investigative research objectives. I feel this is truly a One-Health Challenge as water quality issues affect all animals, humans, and the environment. The "Ethanol Plant X" case study presents a prime opportunity for our One Health Community to integrate research programs and work more collaboratively to examine and address these problems. We hope to meet with you to further discuss this matter, explore potential seed funding opportunities, and brainstorm other ideas about how to address these harmful practices. Below I have listed the internal and external partners interested in participating in a think tank meeting to clarify issues and identify future steps in both the data gathering and potential policy changes.

## LIST OF UNL RESEARCHERS AND NEBRASKA PARTNERS:

| Name | Department | Email | Role/Specialization |
|---|---|---|---|
| Judy Wu-Smart | UNL Department of Entomology | jwu-smart@unl.edu | Honey Bees, Wild bees, Bee Stressors, and Extension Education |
| Autumn Smart | UNL Department of Entomology | asmart3@unl.edu | Honey Bees, Wild bees, Bee Stressors, Pollinator Landscapes |
| John Ruberson | UNL Department of Entomology | jruberson2@unl.edu | UNL Department of Entomology Head |
| Douglas Zalesky | UNL Eastern NE Research & Extension Center | dzalesky2@unl.edu | UNL Eastern NE Research & Extension Center Director |
| Mark Schroeder | UNL Eastern NE Research & Extension Center | mark.schroeder@unl.edu | Farm/Facilities Oper Mgr at ENREC |
| Daniel Snow | UNL Nebraska Water Center | dsnow1@unl.edu | UNL Nebraska Water Center Director |
| Elizabeth van Wormer | UNL School of Veterinary Medicine & Biomedical Sciences | liz.vanwormer@unl.edu | One Health Program Director |
| Steven Comfort | UNL School of Natural Resources | scomfort1@unl.edu | Chemical Toxociologist |
| Tiffany Messer | UNL Biological Systems Engineering Department | tiffany.messer@unl.edu | Nutrient and pesticide cycling, fate, and transport |
| Troy Gilmore | UNL Biological Systems Engineering Department | gilmore@unl.edu | Agricultural nutrient, water fluxes, Groundwater-surface water interaction, Emerging contaminants |
| Steven Thomas | UNL School of Natural Resources | sthomas5@unl.edu | Riparian Ecologist |
| Anthony Schutz | Nebraska College of Law | anthony@unl.edu | Enivornmental Law |
| Tim Creger | NE Dept of Ag | tim.creger@nebraska.gov | Nebraska Department of Agriculture Pesticide/Fertilizer Program Manager |
| Tammy Zimmerman | NE Dept of Ag | tammy.zimmerman@nebraska.gov | Plant Health of the Nebraska Department of Agriculture |
| Buzz Vance | Ne Dept of Ag | buzz.vance@nebraska.gov | Product registratoin specialist at Nebraska Dept. of Agriculture |

## LIST OF EXTERNAL EXPERTS AND PARTNERS

| Name | Department | Email | Role/Specialization |
|---|---|---|---|
| Steven Bradbury | Iowa State University Pollinator Working Group | sgbrad@iastate.edu | Environmental Toxicology, Pesticide Risk Assessment, Sustainability |
| Randall Cass | Iowa State University Pollinator Working Group | randall@iastate.edu | Honey Bees, Native bees, Extension Education |
| Michelle Hladik | USGS California Water Science Center | mhladik@usgs.gov | Pesticide and herbicide contamination, laboratory methods, surface water quality, water quality, waste treatment and disposal |
| John Stark | Washington State University Washington Stormwater Center | starkj@wsu.edu | Director of the Washington Stormwater Center at the WSU Puyallup Research & Extension Center and a member of the Puget Sound Partnership Science Panel. |
| Adam Dolezal | Illinois State University | adolezal@gmail.com | Honey Bees, Native bees, Diseases and Pollination |
| Megan Milbrath | Michagin State University | meghanom@umich.edu | Honey Bees, Native bees, Diseases and Pollination |
| Marla Spivak | University of Minnesota | spiva001@umn.edu | Honey Bees, Native bees, Diseases, Breeding, and Pollination |
| Reed Johnson | The Ohio State University | johnson.5005@osu.edu | Honey Bees, Native bees, Diseases, Pesticides, and Pollination |
| Michael Daniels | US Environmental Protection Agency | daniels.michael@epa.gov | Region 7 Pesticide Contact |
| Jamie Green | US Environmental Protection Agency | Green.Jamie@epa.gov | Region 7 Pesticide Contact |
| Tom Steeger | US Environmental Protection Agency | Steeger.Thomas@epa.gov> | Office of Pesticide Programs |
| Daniel Raichel | Natural Resources Defense Council | draichel@nrdc.org | Staff attorney, pollinator initative, wildlife division, nature program |
| Lucas Rhoads | Natural Resources Defense Council | lrhoads@nrdc.org | Staff attorney, pollinator initative, nature program |
| Jen Sass | Natural Resources Defense Council | jsass@nrdc.org | Senior Scientist, Federal Toxics, Health and Food, Healthy people & Thriving Communities Program |
| Sarah Hoyle | The Xerces Society | sarah.hoyle@xerces.org | Pesticide Program Specialist |
| Aimee Code | The Xerces Society | aimee.code@xerces.org | Pesticide Program Director |
| Steve Ellis | Pollinator Stewardship Council | nhbabsellis@gmail.com | Pollinator Stewardship Council Director/ Commericial Beekeeper |